



Date: April 27, 1984

Subject: Monthly Report - April 1984

From/Location: E. L. Cambridge

To/Location: J. G. Kaufman

Alumina Properties

Proposed alumina specifications for Columbia Falls have been received for review as has a compilation of their experience with dust problems with the Kwinana ore.

A search of abstracts on papers relating alumina properties to smelter operations has been completed and most of the relevant papers are in hand. Organization of the information into a report is underway.

AD-124 Slurry Electrolysis

The 2 ka cell was restarted the week of March 18 and operated for a total of 90 hours. During start-up the electrolyte loss was relatively high 1-2 kg/hr. The start-up period lasted about 48 hours followed by 30 hours of steady state operation. Electrolyte losses increased which resulted in a non steady state operation period which lasted for 12 hours. Electrolyte losses increased to greater than 4 kg/hr which caused shutdown.

During the entire operation period of 90 hours the current efficiency was 63% based on aluminum produced. The alumina consumption based on feed rate was equivalent to 67% current efficiency over the same 90 hours operation. During the 30 hours steady state operation CO_2/CO analysis showed a 97% current efficiency. The steady state cell potential of 4.26 V consisted of 1.92 V external drop and 2.34 V cell internal (anode bottom to aluminum pool). The 1.92 V external contains 1.65 V anode drip which is suspected to be caused by several horizontal cracks noted on post-mortem anode examination. X-ray work and resistance measurements are underway to establish the cause of the anode drop.

If a normal plant external drop of 0.8 V is added to the 2.34 V internal, the projected plant operating voltage at the 1 5/8" ACD utilized during the steady state operation would be 3.14 volts. A similar voltage was obtained during some operation periods of the first 2 ka cell campaign. Utilizing the 97% current efficiency during steady state operation a power consumption of 4.4 kwh/lb results from these analyses.

The objective for electrolyte composition was to operate at CR 1.33, 22% LiF and 875°C. However, due to initially slow analytical results and

high electrolyte loss the desired composition was not achieved after start-up. The electrolyte composition that existed during steady state operation was CR 1.07 and 12.4% LiF. The volatile electrolyte loss during the entire operation ranged from 0.008 to 0.095 lb/lb aluminum produced.

A post-mortem has been performed on the cell. The major electrolyte leak was due to a carbon side wall crack and loss of inner brick mortar. A crack in the cathode along the collector bar did not result in cathode metal penetration. Although electrolyte appeared to penetrate the silicon carbide bricks lining the electrolysis cavity, the bricks remained structurally sound.

Detailed analysis of the operation data and post-mortem analysis is underway for preparation of a formal report.

MLI Technology Implementation

The project plan was presented at Columbia Falls and accepted as being in line with their needs. The AFC was approved and purchase requisitions have been prepared.

NEW PRODUCT/PROCESS OPPORTUNITIES

AD-123

The contract for construction of the plant building was awarded to Pace Construction Company and construction began on April 9. A bid by Bickley Furnace for the high temperature kiln has been approved conceptually. A critical date purchasing schedule for other process equipment is being drawn up and bids are being solicited on items known to have a long delivery time.

The trademark "CERALOX" has been adopted for the high performance ceramic oxide product group. A press release announcing ARCO Metals' entry into this business was sent to prospective customers on April 10 and given general release on April 16. A reception is schedule for the American Ceramic Society Meeting on April 30. Telephone contact with key customers got underway on April 16.

The Cabot 214 alloy kiln tube was received on April 17. Testing of ACH decomposition on the Bartlett/Snow kiln will begin on April 24. In the meantime production of semi-pilot batches of CERALOX 95 is continuing using the shuttle kiln which has been modified with a scrubber to collect ACH decomposition off-gases.

A ball mill test on the initial 350 lb lot of CERALOX 95 indicated that excellent milling characteristics can be expected on a production basis. Milling studies will continue for the purpose of generating sample lots and for evaluation of the effect of calcining parameters on milling

characteristics and ceramic properties. The results will be used to establish processing parameters and to assemble data sheets for current marketing efforts.

Magnesium

Project planning has been completed for work to evaluate and compare the hydrochloric acid and carbonation routes for production of bipolar cell grade feed from magnesite.

A sample of magnesite ore has been obtained from the Basic Refractories Gabbs, Nevada mine. The sample has been run through sample prep and work will be underway by month end.

Enzyme/Whole Cell Immobilization Supports

Jerry Davis and Dan Blake met with personnel from ARCO Bioengineering at Dublin, California on April 12. They provided some basic information on necessary features and technology in the application of bio-supports. Further review of literature and the gathering of price data on competitive support materials is underway at TRC. A preliminary report of findings and recommendations will be presented to interested parties at TRC by month end.

Sol Gels

Preliminary experimental work and planning are underway.

Crackle Substitute

Preliminary planning of activities is underway.

AD-120 CHLORIDE TECHNOLOGY

(1) PCACH Technology

(a) ACH Calcination

The fluid bed calciner was operated for several one day, continuous tests. Production rate is 8 g/min which corresponds to a residence time of 30 minutes.

The chloride levels at 650°C for one or simulated 2-stage operations are lower than those obtained in rotary kilns in similar atmospheres and 1 hour residence times (Cl ~4%). This might indicate that calcination at lower temperatures may be possible in the fluid bed. Experiments at intermediate temperature will be carried out as soon as repairs on a cracked heat exchanger are completed.

(b) Gas Sparging Crystallization

Professor Alan Randolph of University of Arizona was invited for one-half day's consulting. Two companies (HPD and Swenson) in the area of crystallizer design and manufacture were contacted to explore the possibility of alternative designs.

(c) Conceptual P & ID

A preliminary version of the Demo Plant scope has been reviewed and accepted. Frank Traversone has looked it over and does not anticipate any problems with zoning at the TRC. Work on the Process flow diagrams is underway.

(d) Clay Plant Laboratory Work

A preliminary scan of information available for operations in the clay process has been completed. At this time there does not appear to be any major gaps. One area in question is the neutralization of the FeCl_3 solution recovered from the S/X circuit. This solution is reacted with calcined clay to give an AlCl_3 solution and a silica/ $\text{Fe}(\text{OH})_3$ mixture. The solid/liquid separation is accomplished within the leach liquor/silica separation circuit. The potential for a back reaction of $\text{Fe}(\text{OH})_3$ with AlCl_3 solution exists and must be tested.

A second area where further work may be required is in the HCl stripper column. The configurations tested in the pilot plant limited throughput. Contacts with vendors and/or a forthcoming USBM RI may provide sufficient information to remedy the problem. If not, further laboratory work will be required.

(e) Secrecy Agreements

Stan Becker has contacted us with a concern that even 10 years may not meet ARCO Metals/Alcoa contract requirements for confidentiality. Some vendors will not want to be bound that long so a mechanism will have to be developed to provide information in a way that requires shorter periods.

(2) Reactor Technology

(a) CxCly Destruction

The maximum loading factor of WITCO coke at 650°C was determined to be $\frac{0.061 \text{ g}}{\text{g coke}}$ CxCly decomposed or $\frac{0.08 \text{ g coke}}{\text{g Al}}$. This would add approximately $\frac{\$0.08}{\text{lb Al}}$ to production costs, which precludes commercial use of thermal decomposition technology immediately after the reactor.

(b) Chlorination

An empirical model was developed to relate the levels of CxCly's in AlCl_3 to coke physical and chemical properties. CxCly's data for Rodeo Collier coke and Santa Maria coke was used for this model. The coke parameters that were found to be statistically significant which affect the CxCly levels are: weight percent hydrogen, surface area, and weight percent sulfur. The relationship is as follows:

$$[\text{CxCly}] = 660 + 1370[\text{wt \% H}_2] - 10[\text{SA}] + 314[\text{wt \% S}]$$

where SA is the surface area in m^2/gm .

(c) HPFB

The HPFB is fully operational. PCACH and coke with specific particle diameters (75 to 300 μm for PCACH and 75 to 150 μm for coke) are reacted for defined times corresponding to 15%, 50%, and 75% conversion in the pressurized reactor. Reacted material for initial attrition study has been prepared and will be tested soon to identify whether or not attrition of reacted feed will be a problem.

(d) Dye Report

A report on preliminary evaluation of evaporation and condensation of impurity elements during carbochlorination of PCACH has been received. With a small overpressure of chlorine and controlled temperature regimes in the reactor, cyclones, demister and desublimer, the Na and K should to a large extent be separated out in the demister, while V and P should be transported with the CO_2 off-gas for treatment. It will probably be difficult to separate the Mg and Ca from the desublimed AlCl_3 . A model has been applied and critical experiments have been identified.

(3) Coke Preparation

All carbon related activities are on schedule except the final overall heat and material balance on the fluid bed calciner. This will be completed within two weeks.

A meeting was held with Harvey Technical Center personnel concerning the costs and methods of producing coke for the chlorination reactor. It was concluded the most meaningful capital and operating cost information would be obtained through equipment suppliers. We are proceeding to contact KVS and Davie McKee to discuss the feasibility of commercially calcining coke in rotary kilns or fluid beds.

Harvey suggested two alternatives to producing coke with a high surface area and low hydrogen. One method is to "puff" the coke which consists of calcining to 1500°C which drives off the sulfur and creates microporosity. The other method is to control oxidize ($\text{CO}_2 + \text{O}_2$) the

coke at low temperature (540-705°C) to burn out the hydrogen and then if necessary, to achieve higher surface area, calcine under steam at higher temperatures. We will check out these suggestions.

REPORTS

No reports issued this month.

R&D STAFF

Personnel

Jimmie Barajas resigned his technician position after two week's service to take a job at the U of A. We are using a temporary to fill his position until it can be permanently filled.

Production/Innovation Project

Nine Primary Metals R&D employees, in addition to the seven selected at Chicago, have volunteered to participate in the interview process. The interviews will be held at Tucson on April 26 and 27. Fred Dorin from the APC and Chip Kaliher and Debra Peters from Chicago will be conducting the interviews.

Headcount

The breakdown as of month end is:

Managers	3
Professionals	13
Technicians	16
Clerical	1
TOTAL	33


E. L. CAMBRIDGE

ELC:dg

cc: D. M. Blake
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